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ABSTRACT

A study was conducted to determine the relative effectiveness of the traditional and infused (computer-assisted instruction or CAI) approach to basic skills instruction for students in a vocational education program. The sample for the study consisted of 41 male students in the air conditioning/refrigeration program at the Houston Community College System Central Campus. Students, who were mixed racially and ethnically, were given the Wide Range Achievement Test (WRAT) Level II to test their basic skills and the written form of the Student Occupational Competency Achievement Testing Program. An experimental group of 28 students received--in addition to the traditional instruction--approximately four hours per week of basic skills training using PLATO; the control group of 13 received only traditional instruction in which basic skills training was incorporated. The groups were posttested with the WRAT. Results showed that the experimental group receiving the CAI approach did not differ in the WRAT performance test scores from the scores of the control group. Some of the variables that may have affected the outcome were ongoing program development, differences in instruction, and student characteristics. It was concluded that while the results did not support a CAI approach to basic skills training for the vocational students in the sample, the study did illustrate the need to find appropriate ways of infusing basic skills training into the vocational education curriculum. Recommendations were made to evaluate the research design and make changes in the design of future studies, and to find other ways of using CAI to help vocational students to use basic skills. (KC)

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FINAL REPORT

A COMPARISON OF TRADITIONAL VOCATIONAL TRAINING WITH A VOCATIONAL TRAINING MODEL INFUSING REMEDIAL ACADEMIC SKILLS TRAINING

Submitted to the

Texas Education Agency

Vocational Education Special Projects

by

Houston Community College System

Industrial Education Division

June 30, 1986

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PROJECT OBJECTIVES

Problem

The problem to be researched in this study was the effect of academic remedial instruction delivered via microcomputer on the learning of skills material in a vocational education setting.

Students in the Air Conditioning and Refrigeration Program (ACR) at Houston Community College System (HCCS) who received traditional vocational instruction and computer-aided instruction (CAI) in reading and math (experimental group) were compared with students receiving only traditional vocational instruction (control group). Gain scores in academic achievement within and across groups were compared and occupational competency levels were reported for both control and experimental groups.

Project Goals

The purpose of this research was to conduct a study to determine whether the learning of basic skills through computer-aided instruction (CAI) enhances the achievement of students. The study particularly focused on the need for academic skills instruction by non-college-bound vocational students and its application, or transfer, to a non-academic vocational education program. The primary goal of the project was (1) to compare increases in skill levels of traditionally instructed vocational students receiving CAI instruction in traditional academic skills with increases in skill levels of students receiving traditional instruction without the CAI instruction in basic skills; and (2) to present scores achieved on an

occupational competency test by students receiving traditional instruction without the CAI instruction.

In modern education, instructional media has often been used in remedial and study courses, because it tutors and reinforces the student in areas of academic weakness and enhances his learning in other areas of the curriculum. It is practical; it gives drill and practice efficiently, which the vocational instructor may not have the time or expertise to give. It is versatile; it can be used by itself or with accompanying program instructor modules and textbook materials. Currently, the microcomputer is the latest medium to develop the traditional basic skills curriculum into an instructional format that derives from sound learning theory. It saves both the student and the instructor time and energy by increasing time on task. Its application to the vocational education curriculum assumes that, in general

1. vocational students who are given generic remedial academic instruction via microcomputer modules will learn (i.e., absorb, recall, and apply) the vocational content more effectively than they would without the instruction; and

2. vocational students who receive this instruction via microcomputer will benefit (i.e., transfer their training) from an efficient mode of learning that is systematic, individualized, reinforcing, and interactive.

Hypotheses

The hypotheses to be tested in this project were the following:

1. Those students who participate in the traditional and infused (CAI) instruction will show an increase in

vocational achievement gain scores as compared with those students who receive the traditional instruction.

2. There is a difference in academic achievement gain scores between those students participating in the traditional and infused instruction and those students receiving the traditional vocational instruction only.

The instruments used to test these hypotheses were the Jastak WRAT (Wide Range Achievement Test) and the Student Occupational Competency Achievement Test (SOCAT-National Occupational Competency Testing Institute-NOCTI of Air Conditioning/Heating and Refrigeration. Description of these instruments are provided later in this report (page 6).

Extraneous Variables

To safely infer cause-and-effect in an experiment, independent and dependent variables must be clearly defined and extraneous, or confounding, variables should be ruled out as possible causes of changes on the post-test (dependent variable). With such control, the experimenter can attribute the changes to the treatment and not to any other variables.

In the present experiment, the independent variable to be manipulated was the computer-aided instruction (CAI); the dependent variables were the pre- and post-tests of the WRAT. The SOCAT was administered only as a post-test. Extraneous variables are irrelevant to the treatment but can become confounded with it because they occur at the same time.

Research Questions

This research has raised several questions relevant to vocational education and curriculum:

1. Is remedial basic skills instruction essential for a student's success in the training program (i.e., does it make him "trainable" for work)? and
2. Does CAI do a more efficient job of "remediating" the lack of these skills than traditional modes of instruction?

Additional critical considerations for this particular project are:

1. What are the effective uses and applications of computer-aided basic skills instruction in a short-term vocational training program that prepares students as "hands-on" mechanics and service technicians?

2. How can basic skills instruction be successfully integrated into the regular vocational classroom?

Limitations

1. Monthly or flex-entry enrollment of vocational students is college policy; therefore, the period of instruction and treatment was limited (3-4 months).

2. The occupational competency test instrument selected was intended for secondary and post-secondary students who have been in a vocational program for 9-12 months.

3. Students might drop out or transfer before completion of the project.

4. The sample was small (10-20 for each group); however, the experiment was repeated two times and the results of both test groups (Fall and Spring) combined.

Short And Long Range Benefits

Benefits of this research to the Air Conditioning and Refrigeration program at HCCS and other similar vocational programs would be the following:

1. Supplementation of traditional instruction by using and/or adapting computer curriculum material that is easily accessible and self-instructional;

2. Integration of basic skills instruction into the ACR vocational curriculum;

3. Increased utilization of learning center resources and materials to enhance vocational learning;

4. Dissemination of results and products of the research to other vocational programs within HCCS and HISD systems, and to other regional and state vocational schools and community colleges; and

5. Ongoing development, use, and application of microcomputer materials by the ACR and other vocational programs at HCCS.

PROCEDURES

Research Design

The research design to carry out this project was essentially a pre-test, post-test design using control and experimental groups. These groups were composed of intact classes of students; the classes were assumed to be comparable. Because random assignment was not possible, a quasi-experimental research design was used.

Both control and experimental groups were given a pretest using a standardized achievement test, the Wide Range Achievement Test (WRAT). This test measured basic skills in reading, arithmetic, and spelling.

Treatment was then given to the experimental group. Following the period of treatment, post-testing was conducted using the WRAT and also a standardized written occupational competency test, the Student Occupational Competency Achievement Test (SOCAT). In conjunction with the testing, a demographic survey was also administered. Data was gathered following the pre- and post-testing activity.

Test results were compared within groups to measure academic achievement gains as well as between groups to compare achievement gains on the WRAT. These results were examined for statistical significance and final results reported. Results of the SOCAT occupational competency test were reported and presented.

Generalizability of Findings

The results of this research can be generalized to the population from which the sample was drawn, the ACR vocational program, for only those programs with characteristics and populations similar to the HCCS ACR program.

Test Instruments

WRAT - The academic achievement test selected for this quasi-experimental study was the Wide Range Achievement Test Level II (WRAT), a standardized test with three sub-tests: reading, spelling and arithmetic. It takes approximately 20-30 minutes to administer and is hand-scored. Only one form of the WRAT is used for both test and retest.

The WRAT has practical applications in many areas. For the specific purpose of this experiment, the applications were:

1. Diagnosis of reading, spelling, and arithmetic disabilities; and
2. Determination instructional levels.

The test has been shown to be an accurate measurement of the three basic academic skills. The three subtests at Level II are:

1. Reading: recognizing, naming, and pronouncing words out of context
2. Spelling: writing single words to dictation
3. Arithmetic: performing written computations

Raw scores were used to measure the test variables. They indicated within the limits of standard error whether or not an individual did better than another individual or better than a previous assessment of the same individual.

SOCAT - The Student Occupational Competency Achievement Testing Program was designed to measure the competency of completers of secondary vocational programs or technical program of community colleges or technical institutes. The SOCAT was not designed to be used as pretest or capsulized measurement tools.

Each vocational test examines the student to establish the level of occupational competency in representative areas of the occupation. Both written and performance tests may be administered; however, for purposes of this research, only the written test was used.

Demographic Data

A survey was designed to gather demographic data on the ACR Program students participating in the experiment.

Variables included in the Houston Community College System Air Conditioning/Refrigeration Survey (Appendix C) were the student's following characteristics:

1. sex
2. age category
3. ethnicity
4. marital status
5. primary language
6. difficulty in understanding English in the classroom
7. present employment status
8. relationship of present job to ACR classes at HCCS
9. employment in ACR field prior to enrollment
10. previous computer experience
11. major program of study
12. educational level
13. primary educational goal
14. reason for attending HCCS

15. primary source of educational funds
16. personal income
17. household income
18. disability/handicap requiring special services
19. student status at time of admission to HCCS
20. vocational courses taken in high school
21. enrollment in a vocational technical school or program prior to enrollment in the ACR program

Setting

The Houston Community College System is accredited by the Commission on Colleges of the Southern Association of Colleges and Schools. Programs in technical and vocational education have been approved by the Texas Education Agency. The College has an open-door admissions policy. In 1984-1985 the HCCS enrollment exceeded 55,000. It shares facilities with the Houston Independent School District; at present there are 36 campuses throughout the city.

Objectives of the College include the following:

1. To provide occupational and technical instruction which, through certificates of completion or associate degree plans, prepares individuals for immediate employment in skilled and semi-skilled occupations and to provide supplementary training to upgrade job skills; and

2. To provide resources for learning that supplement and enhance classroom instruction.

The Houston Community College System Central Campus was selected to participate because it offered a variety of vocational training programs; served a mixed student population, including special needs students; and had the equipment, resources, and personnel to conduct the research.

Site

The site selected for the experiment was the Computer-Based Education Center (mobile computer van) located at the Central Campus of Houston Community College. It was decided that the treatment should be administered at one location. The van holds 23 computer stations (Control Data 110s), each equipped with a floppy disk drive and monochrome monitor.

Traditional Vocational Instruction

Students in the ACR vocational program at HCCS are generally not given pre-assessment testing at entry. Traditional instruction covered during the period of CAI treatment included Phase I (Basic Electricity and Refrigeration I), a period of approximately 16 weeks. No computer-aided instruction was included.

Course objectives and content were comparable from one class to another; however, the instructional teacher-made and published materials varied from class to class. In addition to standard textbooks, some instructors also required manufacturers' instruction manuals (such as those on ACR by Whirlpool). Trade journals and newspapers, such as those which might be encountered on the job, appeared to be optional. Further, students were directed to use videotapes, slides and reference materials.

Traditional instruction also included job-related basic skills instruction (technical terms and technical math).

Sample

The sample consisted of students enrolled in the ACR program from Fall, 1985 to Spring, 1986.

Fall Group - Approximately 26 students enrolled in the ACR Program were pre-tested on November 1, 1985. Treatment began on November 14. The students in the Fall experimental group received approximately 40 hours of computer assisted instruction in addition to the traditional program. The control group attended traditional classes only. Students in the experimental groups were post-tested following treatment, and students in the control groups were post-tested at a comparable point in their program.

Spring Group - Seventeen new student enrolled in the regular ACR program on January 28, and were pre-tested February 4. The CAI treatment was begun on February 4. Students in the Spring experimental group received approximately 40 hours of CAI instruction in addition to the traditional program. The control group attended classes in traditional instruction only. Post-testing of participants in both the control and experimental groups was done on May 7.

Treatment

The CAI treatment administered to the experimental group consisted on approximately 40 hours of a computer-aided basic skills instructional program (PLATO, Control Data Corporation). This was a generic rather than a content-specific program. The treatment was conducted during the regular classroom hours, 7 a.m. to 1 p.m., for two hours a day, twice a week.

CAI instruction (treatment) was individualized and placement level was determined by WRAT pre-test scores. All students began the CAI math lessons and tests and progressed to the reading and writing modules, one or two hours per week were spent on math, especially those areas in which the students needed more drill and practice to aid retention.

Hardware and Software Used in the Treatment

The microcomputer software package used in the treatment is the Control Data PLATO Microcomputer System Reading and Mathematics Series. It is designed to be used with the 8-inch floppy disk Control Data 110 microcomputer.

The method of instruction used in the experiment depended on the individual student. For students whose skills were low, the recommended sequence was: lesson followed by post-test. For those students who could move more quickly through known material to unfamiliar material, "testing-out" was preferred: pre-test-lesson to post-test. Further, a review or application module was provided at the end of most courses.

The PLATO Basic and High School Math Skills correspond to the WRAT-Math subtest. The Reading Basic Skills corresponds to the WRAT-Reading subtest; and the PLATO Writing Course 1 to the WRAT-Spelling subtest. The rest of the PLATO reading and writing courses include comprehension, grammar and composition, which are not measured by the WRAT.

Equity Checklist = a checklist which evaluates the PLATO Program for sex fairness is in Appendix D.

RESULTS

This study was conducted (1) to determine if the learning of basic skills through computer-aided instruction (CAI) enhances skills learning; and (2) to assess the level of occupational competency achieved by students during the experimental period of traditional vocational instruction and traditional and infused (CAI) instruction.

The Wide Range Achievement Test (WRAT) was used to measure the basic skills of both groups of students. The date from the WRAT, SOCAT, and the Air Conditioning/Refrigeration Program Survey were analyzed and are presented.

Description of the Sample

The sample for this study consisted of 41 males who completed the Air Conditioning/Refrigeration Program Survey, pretest and posttest WRAT, and the SOCAT. Twenty-eight males or 68.3% were in the experimental group and 13 males or 31.7% were in the control group. The age category ranged from 16 to 54 years.

Ethnic Make-Up - The total sample included American Indian/Alaskan, Asian/Pacific Islander, Black, Hispanic, and White. In the experimental groups the following ethnic groups were represented: 8 or 19.5% were Asian/Pacific Islander, 10 or 24% were Black, 3 or 7.3% were Hispanic, and 7 or 17.1% were White. In the control group, the following ethnic groups were represented: 1 or 2.4% were American Indian/Alaskan, 3 or 7.3% were

Asian/Pacific Islander, 3 or 7.3% were Black, 1 or 2.4% were Hispanic and 5 or 12.2% were White.

Language - The primary language make-up of the total sample included English, Spanish, Asian/Oriental, and others. In the experimental group the following was represented: 20 or 48.5% spoke English and 2 or 4.9% spoke Asian/Oriental languages.

Difficulty in understanding the English language in the classroom was indicated by a "yes" response from 7 or 17.1% and a "no" response from 21 or 51.2% in the experimental group, while the control group responded "yes" by 0% and "no" by 13 or 31.7%.

Highest Grade Completed - The educational preparation of the total was varied, from less than 12 years of school to college graduate. The experimental and control groups had the following modes: 1 or 2.4% in grade 8, 2 or 4.9% in grade 9, 5 or 12.2% in grade 10, 5 or 12.2% in grade 11, 22 or 53.7% in grade 12, 1 or 2.4% in grade 13, 2 or 4.9% in grade 14, 1 or 2.4% in grade 15, and 2 or 4.9% in grade 16. Thus, 85.4% of the total had a high school education/G.E.D. equivalency or less.

Inferential Analysis - WRAT

The major focus of this study was related to the amount of knowledge of basic skills gained through CAI by students in a vocational education program. The research hypotheses were as follows:

1. The experimental group receiving the CAI approach will not differ in the WRAT performance scores from the WRAT performance scores of the control group; and

2. The experimental group receiving the CAI approach will differ in the WRAT performance scores from the WRAT performance scores of the control group.

The following date of the pretest and posttest scores on the WRAT-Math, WRAT-Reading, and WRAT-Spelling were tabulated for the 41 subjects; mean raw scores, median, standard deviation, range, minimum and maximum (Table 1, Table 2, and Table 3).

Inferential statistics were used to evaluate the hypotheses. A two-way analysis of variance (ANOVA) tested the two hypotheses. The level of significance was set at p. <.05. The two-way ANOVA was used to make comparisons between the two groups and within the two groups.

Math - A two-way ANOVA of the WRAT-Math revealed statistically significant differences in the total test scores between the experimental and control groups. Between group differences and within group differences were significant at the .01 level. A Newman-Keuls post-hoc test was performed to determine specifically which group contributed to this significance. Findings were as follows:

1. within the experimental group no significant gains were noted from the pretest to the posttest;
2. within the control group significant gains were noted from the pretest to the posttest;
3. between the control and experimental group on the pretest, no significant differences were noted; and
4. between the control and experimental groups on the posttest, the control group was significantly higher (Table 4).

Reading - A two-way ANOVA of the WRAT-Reading revealed statistical significance within the groups. A post-hoc Newman-Keuls test was performed to determine specifically which group contributed to this significance. Findings were as follows:

1. there were no significant differences between the experimental and control groups on the pretest;

2. when the treatment was given, a significant gain was noted from the pretest to posttest in both the experimental and control groups; and
3. therefore, on the posttest there remained no significant difference in the experimental and control groups (Table 5).

Spelling - A two-way ANOVA of the WRAT-Spelling revealed statistical significance between groups. A post-hoc Newman-Keuls test was performed to determine specifically which group contributed to this significance. Findings were as follows:

1. the control group means were significantly higher than the experimental group means;
2. when the treatment was administered there were no significant gains from the pretest to the posttest in either the experimental or control group;
3. therefore, the scores for the control group remained significantly higher than the scores for the experimental group (Table 6).

Conclusion

This study did not identify a statistically significant difference in the mean posttest between the experimental and control groups. Therefore, this study failed to reject the null hypothesis. The experimental group receiving the CAI approach did not differ in the WRAT performance test scores from the scores of the control group.

A Pearson correlation coefficient was used to determine if there was a relationship between the pretest and posttest of both groups on the three areas of the WRAT-Math, WRAT-Reading, and WRAT-Spelling. It was established that there were statistically significant relationships (Table 7).

Changes in WRAT Grade Levels

Grade level ratings were derived from raw scores achieved on the WRAT subtest. Grade ratings were expressed by grade year and month (e.g., 7.5 = 7th grade, 6th month).

SOCAT Results

Test data were reported by the NOCTI in per cent achieved scores. These scores were provided for individual students for each test sub-category and test total, with comparisons by percent to the students' group, experimental or control, and to other students who have taken the test nationwide (Table 8).

Occupational Competency Tests - Each occupation, Heating/Air Conditioning and Refrigeration, is represented in the sample by the control group and the experimental group.

Findings: Bilingual ACR Program

In addition to the experiment conducted which involved students from the regular Air Conditioning and Refrigeration Program, a parallel study was done within a separate program, the Bilingual ACR Program, which consisted of Hispanic students.

The same experiment was conducted under the same conditions for this student population, except for the period of traditional instruction, which included Phase I and Phase II of ACR.

The Bilingual ACR study was conducted to provide additional information to HCCS concerning a vocational program with the same curriculum and methodology as that of the regular ACR program but a different student population with special educational needs.

Inferential Analysis - WRAT

The date of the pretest and posttest scores on the WRAT-Math, WRAT-Reading, and WRAT-Spelling were tabulated for the 21 subjects: mean raw scores, median, standard deviation, range, minimum and maximum.

Inferential statistics were used to evaluate the hypotheses. A two-way analysis of variance (ANOVA) tested the two hypotheses. The level of significance was set at $p<.05$. The two-way ANOVA was used to make comparisons between the two groups and within the two groups.

A two-way ANOVA of the WRAT-Math revealed no statistically significant differences in the total test scores between the experimental and control groups.

A two-way ANOVA of the WRAT-Reading revealed no statistical significance between groups.

A two-way ANOVA of the WRAT-Spelling revealed no statistical significance between groups.

This study did not identify a statistically significant difference in the mean posttest between the experimental and control groups for the Bilingual ACR Program sample. Therefore, this study failed to reject the null hypotheses. The experimental groups receiving the CAI approach did not differ in the WRAT performance test scores from the scores of the control group.

A Pearson correlation coefficient was used to determine if there was a relationship between the pretest and posttest of both groups on the three areas of the WRAT-Math, WRAT-Reading, and

WRAT-Spelling. It was established that there were statistically significant relationships.

SUMMARY AND RECOMMENDATIONS

Objectives of the Study

The objectives of the study were as follows:

1. To determine the effectiveness of the traditional and infused (CAI) approach to basic skills instruction for students in a vocational education program;

2. To draw conclusions to make recommendations based on the evaluation of results and other variables affecting the results.

Summary of Results

The experimental group receiving the CAI approach did not differ in the WRAT performance test scores from the scores of the control group. In other words, results indicated that the experimental group did not perform at the expected level following treatment.

On the WRAT-Math within-group and between-group differences on the post-test were significant for the control group. Results of the WRAT-Reading showed significant gain within the groups for both the control and experimental groups, but no difference between the groups on the pre- and post-tests. On the WRAT-Spelling, the control group scores remained significantly higher than the scores of the experimental group from pretest to posttest.

In the Bilingual ACR Program sample, there were no significant differences between the groups on the Reading, Math, or Spelling subtests.

While this study did not identify a statistically significant difference in the mean posttest between the experimental and

control groups, it did focus on important variables which may have affected the overall results.

Implications of Findings

Based on an analysis of the data, interviews with instructors, and observation and follow-up of students, certain variables have been identified which may have affected the results. In the investigator's opinion, these variables include ongoing program development, differences in instruction, and student characteristics.

Program Development - While computer-aided instruction was used to give remedial basic skills training to the Air Conditioning and Refrigeration students in the sample, a fully developed program integrating basic skills into the vocational curriculum has not yet been realized. The CAI treatment could not be realistically "infused" as an effective and efficient alternative to prerequisite courses or supplement to other instructional media in the relatively short span of time available during the experiment.

Differences in Instruction - Some of the intact classes selected for experimental and control groups were taught by different instructors and at different times during the school year (because of monthly enrollment). Different styles of delivery presentation and/or variations in emphasis may have accounted for differences in whether or not students improved their reading, writing and computational skills through the vocational content and instructional application. Further, the period of vocational

instruction during the project may have been too short to reflect expected learning outcomes.

Student Characteristics - Results of the statistical analysis of the data revealed some significant information relating to achievement and motivation. The results indicated that, while both the experimental and control groups showed significant gains from pre- to post-testing on the reading, only the control group scored higher on the math. There was a strong correlation noted between the WRAT pre- and post-test Reading and Math (Table 9). This may indicate that there is a great deal of reading required to achieve in math, including technical terms, and students with more preparation, practice, or instruction may perform better in several overlapping areas.

Observation and Follow-Up of Students - Students in the experimental group were observed throughout the treatment period, and both control and experimental groups were informally interviewed during and after the treatment.

Students who did not have reading or language problems perceived reading content in the PLATO program as uninteresting and less relevant to the ACR job training than math or writing (in general, however, students believed that reading skill was as important as math skill for success in ACR). This may be one factor that led to a loss of motivation and interest. Further, some students functioning above 6th or 7th grade reading level may have started at too low a level during the treatment.

Other factors which apparently influenced the outcome were: pressure and priorities both in and out of school (e.g.,

finishing projects, going on job interviews, etc.), a loss of interest or lack of effort while taking the WRAT posttest, a lack of incentive to complete the CAI training or to perform well in it. In general, students seemed to have a greater felt need to improve their math skills; in the Bilingual program, however, several students put a greater emphasis on improving their English and vocabulary skills. Although all students were given the same basic skills training, the instruction was individualized. In addition, some students may have spent more time on one skill than on another, even though they may have needed just as much remediation and practice in other skills.

The majority of students had no previous experience with computers in or out of school. On the positive side, students in the sample felt that the computer program helped them with ACR and that they had learned something. Further, they liked working by themselves on the computer and said they got help when they needed it. When asked if they would like to continue working on the computer (experimental group), most said yes. However, in the Bilingual group some said no and many responded that they would "if they had the time." When the control group was asked if they would like to try the computer, half responded "yes" and more than half said "no" or "if they had the time."

Negative reactions to the experiment included:

1. there was too much test taking
2. using only one computer program was boring, and
3. the feedback in PLATO was too slow.

Other variables which may have contributed to the results are:

1. a small population, and
2. attrition in the sample

In addition, one or two outliers (students who show abnormally large differences in scores from pre- to post-test) and non-discriminating testers on the WRAT-Reading test (word-calling) could have had an effect. A change in one score in a small sample could make a large difference.

Students in the sample who dropped out of the ACR program or left the treatment usually did so for one of the following reasons:

1. they had job interviews scheduled
2. they got part- or full-time jobs
3. they had to complete vocational program projects
4. they transferred to the evening program, or
5. they had college degrees or professional backgrounds.

Occupational Competency Test - The SOCAT did not provide information on how well students perform in comparison with each other. Rather, the SOCAT test presents the average percent achieved scores of the control and experimental groups in comparison with the national average. It further identifies the competencies required for an entry-level knowledge of ACR as well as the assumed verbal and cognitive skills (Academic Aptitude Test) necessary to complete a vocational education program successfully.

Low group average percentile scores were noted for this sample in subjects pertaining to heating/oiling maintenance and service. In academic aptitude, low scores were noted for the Bilingual ACR groups. On the Heating/Air Conditioning and Refrigeration tests, all groups scored significantly lower than the national average, with the exception of the regular ACR control group (Table 11).

An important fact to note is that the period of traditional instruction consisted of Phase I of the Regular ACR Program (Basic Electricity and ACR Fundamentals), whereas the Bilingual ACR Program covered Phase I and Phase II of the ACR instruction during the experiment. Thus, for regular ACR students, the content of their instruction did not match the test content, and in the Bilingual groups, their mastery of English may have been insufficient for reading and understanding the test items.

The implications of the SOCAT test results for this sample are that:

1. the ACR program at HCCS does not include heating and oil equipment service and repair in its instructional curriculum; therefore, this could account for low student performance on these subtests; and,

2. standardized competency tests for students who are not completers or are limited English proficient may be inappropriate, and thus students in the sample were not prepared.

In summary, the SOCAT test is intended for students who complete the vocational program and for students competing for jobs at the national level. If the program's aim is to assess the level of its students, then locally developed materials can be used. However, if the goal is to improve instructional quality and prepare students for the national as well as the local and regional job markets, then a national standardized test should be given. At the least, national competency standards should be considered and adapted to local specific needs.

Conclusions

Based on the findings and implications of the study the investigator concluded:

1. There was a limited amount of time for the vocational students to learn basic skills and vocational content; a longer period of treatment or more time on task may have led to greater achievement gains and higher competency levels;

2. Students lacked motivation of interest in study other than "hands-on" training, and this may have affected their performance on the posttest;

3. Results may have been affected by several variables, such as: instructor effects, student attributes, inappropriate testing instruments, and too small a sample;

4. The treatment may have been weakened by using a CAI program that provided an exclusive mode of basic skills training vs. several media which would provide multiple reinforcement; and

5. Poor performance on the posttest appeared to be caused by students' indifference, lack of effort, feelings of pressure, frustration, etc.

In conclusion, while results did not support a CAI approach to basic skills training for the vocational students in the sample, the study did illustrate the need to find appropriate ways of infusing basic skills training into the vocational education curriculum.

Recommendations

This research has raised questions concerning the effectiveness of computer-aided basic skills training for students in a maintenance-type vocational training program.

It has asked an even more critical question: What can be done to make CAI appropriate and effective for high-risk, "hands-on"-oriented students who lack prerequisite basic skills?

Research has supported the effectiveness--and efficiency--of using CAI. Further, it has reported achievement gains for students at all levels who learn through computer-aided instruction.

Yet, it is important to keep in mind the variance in student populations, students' individual differences, and their educational and vocational goals before selecting a specific application of any media of instruction, including CAI. It is essential to consider the following areas pertaining to the entering students'

1. previous preparation
2. instructional level
3. purpose for attending the program
4. motivation and interests; and
5. characteristics and attitudes.

The ultimate benefit of such an approach would be to the student who lacks the time, the motivation and the preparation to be <u>trainable</u> as well as successfully trained for work.

The following recommendations are made based on the results of this study.

1. To conduct further research to determine the effect of variables such as instructor differences, student characteristics, and CAI methods and media on achievement gains in post-secondary vocational programs;

2. To explore and evaluate the most appropriate and effective research designs, length, and type of treatment, and use of standardized testing to meet expected outcomes;

3. To continue to ongoing integration of basic skills training and materials into the vocational curriculum

and to develop basic skills in relation to and parallel with the vocational curriculum;

4. To establish an "achievement-incentive" process of program interviewing, counseling, assessment and appropriate skills training for individual vocational students at entry and throughout the training program;

5. To investigate the uses and applications of CAI in other vocational programs and evaluate results of their research;

6. To encourage faculty commitment and require training in CAI for instructors or provide related instruction specialists prior to students' use of computer media;

7. To require computer-aided basic skills training as part of the students' program and grade;

8. To provide CAI facilities and equipment in closer proximity to the vocational classroom so that students can be monitored and assisted more attentively;

9. To allow ample time-on-task during computer-aided instruction, particularly for those students weak in basic skills; and

10. To demonstrate CAI as an efficient way to learn and reinforce basic skills during the training program, especially to the "high risk" student who may be unaware of the need for academic or remedial learning or place less value on it.

TABLE 1

COMPARISON OF PRETEST AND POSTTEST SCORES OF THE EXPERIMENTAL AND CONTROL GROUPS FROM THE WIDE RANGE ACHIEVEMENT TEST - MATH

(N=41)

	PRETEST	POSTTEST
MEAN RAW SCORES	22.585	24.600
MEDIAN	22.000	23.500
STANDARD DEVIATION	6.305	6.834
RANGE	22.000	26.000
MINIMUM	12.000	13.000
MAXIMUM	34.000	39.000

TABLE 2

COMPARISON OF PRETEST AND POSTTEST SCORES OF THE EXPERIMENTAL AND CONTROL GROUPS FROM THE WIDE RANGE ACHIEVEMENT TEST - READING

(N=41)

	PRETEST	POSTTEST
MEAN RAW SCORES	53.098	57.400
MEDIAN	56.000	58.500
STANDARD DEVIATION	13.002	12.713
RANGE	46.000	55.000
MINIMUM	28.000	28.000
MAXIMUM	74.000	83.000

TABLE 3

COMPARISON OF PRETEST AND POSTTEST SCORES OF THE EXPERIMENTAL AND CONTROL GROUPS FROM THE WIDE RANGE ACHIEVEMENT TEST - SPELLING

(N=41)

	PRETEST	POSTTEST
MEAN RAW SCORES	26.244	26.175
MEDIAN	28.000	27.000
STANDARD DEVIATION	9.715	9.470
RANGE	38.000	38.000
MINIMUM	9.000	8.000
MAXIMUM	47.000	46.000

TABLE 4

TWO-WAY ANALYSIS OF VARIANCE OF THE WRAT-MATH BETWEEN THE EXPERIMENTAL AND CONTROL GROUPS

(N=41)

SOURCE OF VARIATION	SUM OF SQUARES	DEGREE OF FREEDOM	MEAN SQUARED	F	P
BETWEEN GROUPS	922.72527	1	922.72527	7.23	0.01*
WITHIN GROUPS	430.82940	1	430.82940	6.10	0.01*
ERROR BETWEEN GROUPS	4974.27473	39	127.54551		
ERROR WITHIN	2755.39011	39	70.65103		
INTERACTION	159.51233	1	159.51233	2.26	0.14

*p<.05

TABLE 5

TWO-WAY ANALYSIS OF VARIANCE OF THE WRAT-READING BETWEEN THE EXPERIMENTAL AND CONTROL GROUPS

(N=41)

SOURCE OF VARIATION	SUM OF SQUARES	DEGREE OF FREEDOM	MEAN SQUARED	F	P
BETWEEN GROUPS	788.72635	1	788.72635	2.57	0.11
WITHIN GROUPS	505.40927	1	505.40927	9.88	0.00*
ERROR BETWEEN GROUPS	11970.39560	39	306.93322		
ERROR WITHIN	11994.39560	39	51.13835		
INTERACTION	0.04342	1	0.04342	0.00	0.97

*p<.05

TABLE 6

TWO-WAY ANALYSIS OF VARIANCE OF THE WRAT-SPELLING BETWEEN THE EXPERIMENTAL AND CONTROL GROUPS

(N=41)

SOURCE OF VARIATION	SUM OF SQUARES	DEGREE OF FREEDOM	MEAN SQUARED	F	P
BETWEEN GROUPS	1432.10413	1	1432.10413	7.00	0.01*
WITHIN GROUPS	153.43072	1	153.43072	2.11	0.15
ERROR BETWEEN GROUPS	7978.11538	39	204.56706		
ERROR WITHIN	2835.81319	39	72.71316		
INTERACTION	201.43072	1	201.43072	2.77	0.10

*p<.05

TABLE 7

PEARSON PRODUCT MOMENT CORRELATION OF THE PRETEST AND POSTTEST SCORES ON THE WRAT-READING, SPELLING, AND MATH

(N=41)

	WPR	WPS	WPM
PWR	.89*	.88*	.39*
PWS	.82*	.96*	.57*
PWM	.48*	.57*	.90*

*p<.05

TABLE 8

A COMPARISON OF SAMPLE CLASS AVERAGE AND NATIONAL AVERAGE PERCENT ACHIEVED SCORES ON THE SUBCATEGORIES OF THE SOCAT (Regular ACR)

(N=41)

	EXPERIMENTAL	CONTROL	NATION
Academic Aptitude			
Vocabulary	57%	67%	69%
Analogies	56%	66%	68%
Sequence	64%	76%	70%
Memory	57%	67%	71%
Heating/Air Conditioning			
Theories of Air Cond	47%	66%	54%
Theory of Oil/Gas Htg	28%	32%	60%
Electricity	45%	47%	55%
Install/Service AC Equip	36%	42%	64%
Install/Service Oil/Gas Htg	38%	26%	63%
Pumps/Solar/Hydronic	28%	34%	58%
Psychometrics/Air Movement	41%	50%	66%
Refrigeration			
Theory and Fundamentals	40%	58%	70%
Valves/Gauges/Controls	39%	53%	67%
Electricity	63%	63%	69%
Related Math and Science	35%	52%	50%
Install/Service	34%	44%	62%

SEX EQUITY CHECKLIST

The following checklist has been adapted from sex fairness-in-education national guidelines[1] and meets the requirements of the current research project to provide a checklist which examines and evaluates instructional materials and media for sex bias.[2] Only those categories of the guidelines which are the most applicable to the PLATO program have been selected to develop the checklist.

Specifically, the purpose of the checklist is to determine whether there is equal treatment of, and reference to, male and female characters and persons presented in the PLATO Microcomputer System Reading and Mathematics Series courseware used in the project.

1 Guidelines to Ensure Sex Fairness in Education Division Communications and Products, National Advisory Council on Women's Educational Programs, Washington D.C., 1978, pp. 1-12.

2 Aleen P. Nilsen et al., Sexism and Language, (Urbana, Illinois: National Council of Teachers of English, 1977), p. 182.

Sex bias is defined as "words or actions that arbitrarily assign roles or characteristics to people on the basis of sex. Originally used to refer to practices that discriminated against women, the term now includes any usage that unfairly delimits the aspirations or attributes of either sex."

"Sex equity" is a ten-year-old modern educational concept pertaining to equal presentation and treatment of men and women in textbooks and other media[3] used to instruct students in traditionally male-and female-dominated occupations; it also applies to such treatment in any academic or non-academic subject taught at any educational level.

The checklist was completed by project staff after evaluating a random sample of the PLATO computer software used in the project. "Yes" was checked if the statement was generally true and "no" was checked if it was not true based on the random sample. Exceptions are noted by an asterisk (*).

In general, characterizations and content appear to reflect familiar, real-life situations. Overall, the "comic relief" style of presentation and cartoon characters provide a humorous rather than an offensive context.

[3] Texas House Bills 1303/1304 have mandated the development of standards and guidelines for educational computer hardware and software.

	Yes	No	Examples Explanations
1. Are both male and female characters presented in equal proportion in the graphics and animation of the computer modules?	___	___	_____
2. Is equal reference made to both males and females in the text itself (e.g. games, reading passages, sentence writing)?	___	___	_____
3. Are male and female references varied or alternated throughout the text?	___	___	Appears to be more female references in sequence
4. Is language used that encompasses both sexes (e.g. nongender or universal referents such as <u>you</u>, <u>they</u>, <u>people</u>; <u>generic</u> <u>"he/she"</u>)?	___	___	_____
5. Are both male and female "superiority" roles absent from the graphics and the text?	___	___	Female animation shows superiority over male - i.e. female first gets the idea and gives it to the male; female criticizes male
6. Whenever possible, are both sexes represented in illustrations portraying groups?	___	___	_____
7. Are the physical attributes and personal appearance of males and females described without judgments about what is "proper" to each sex?	___	___	Not found in most modules reviewed. *(To teach object/ predicate) Joe kicked the ball/This librarian's legs are skinny.

8. Are emotional and character traits, roles and activities assigned nondiscriminately to both sexes?	___	___	Females appear smarter in animation; some male stereotypes, e.g., Ken Krunch, Johnny Jock
9. Are careers or jobs represented as appropriate to either sex?	___	___	*Minimal stereotyping of female and male, occupations, e.g. female nurse/ male doctor
10. Are cartoons and illustrations which demean racial/ethnic minorities of either sex absent?	___	___	_____
11. Are both male and female cartoon cartoon characters, neutral graphics or stick figures used to teach a rule/present a concept or signal a response/give feedback?	___	___	e.g. Clever-neutral; Back Track-neutral; neutral figure going up and down steps stick; Scribbler-male; Ken Krunch male; Johnny Jock-male; Magician-male; Lotta Detail-female; Laser Lady-female
12. Is gender downplayed by using neutral, stick and cartoon figures in comic situations throughout the modules?	___	___	Usually both sexes are represented to get a point across e.g. the nurse talking to the doctor; a mother speaking to her son
13. Are characters sometimes thinly disguised as male and/or female/neuter?	___	___	"Head" figures: graduating student, big game hunter, person reading a newspaper